Ocean Battlespace Sensing (OBS) S&T Department Annual Report

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LONG-TERM GOALS

To understand and quantify processes mixing the ocean.

OBJECTIVES

In November 2011 we participated in NRL's Mixing Over Rough Topography (MORT) program focused on East Flower Garden Bank, on the outer continental shelf southeast of Galveston, Texas (Fig. 1). Our objectives are to: 1) understand the three-dimensional velocity and scalar fields around the bank and how they respond to wind forcing over the bank and to low-frequency flows impinging on the bank, and 2) identify hydraulic controls, and 3) quantify mixing rates and relate them to the processes generating them.

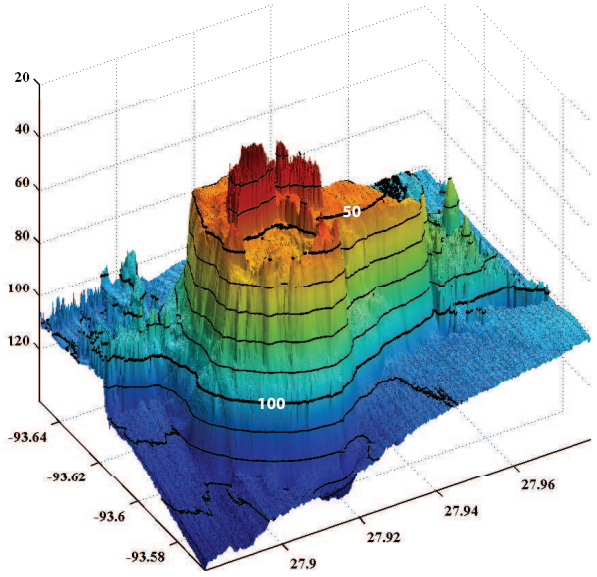

Figure 1: East Flower Garden Bank with isobaths at 10 m intervals.

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APPROACH

Most measurements were made with SWIMS3, a depth-cycling towed body carrying up and down 300 kHz acoustic Doppler current profilers (ADCPs). When weather permitted, SWIMS3 was run along a grid pattern centered on the bank, rerunning the same pattern multiple times to observe changes during a tidal cycle. Figure 2 shows one pattern, grid1, which executed four times in succession early in the cruise and again several days later. Some later patterns used individual legs from this grid to concentrate on specific features in the water tied to the bathymetry. In addition, several lines were run using Modular Microstructure Profilers (MMPs) to measure mixing more directly.

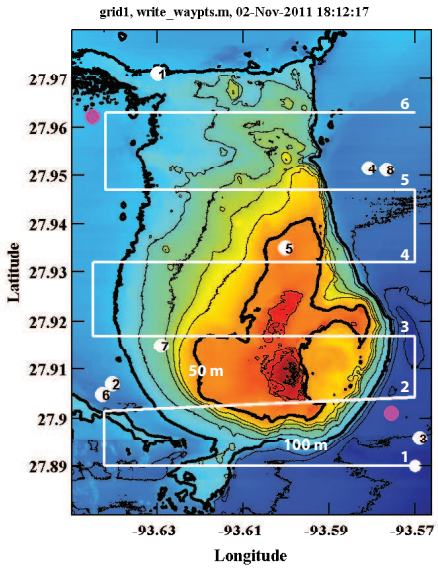

Figure 2: grid1 tow lines used with SWIMS3. East-west legs are numbered starting at the bottom. Maroon circles mark oil rigs, and numbered white circles show NRL moorings.

WORK COMPLETED

The cruise was executed successfully and the data are now being analyzed scientifically.

RESULTS

Intense mixing was frequently found over and near the sill, as shown by the example in Figure 3. This example resulted from low-frequency flows impinging on the sill. Over the shallowest part of the sill, surface forcing was a major factor, and the data are being analyzed to separate and quantify these aspects and to relate them to the mooring records being analyzed by NRL investigators.

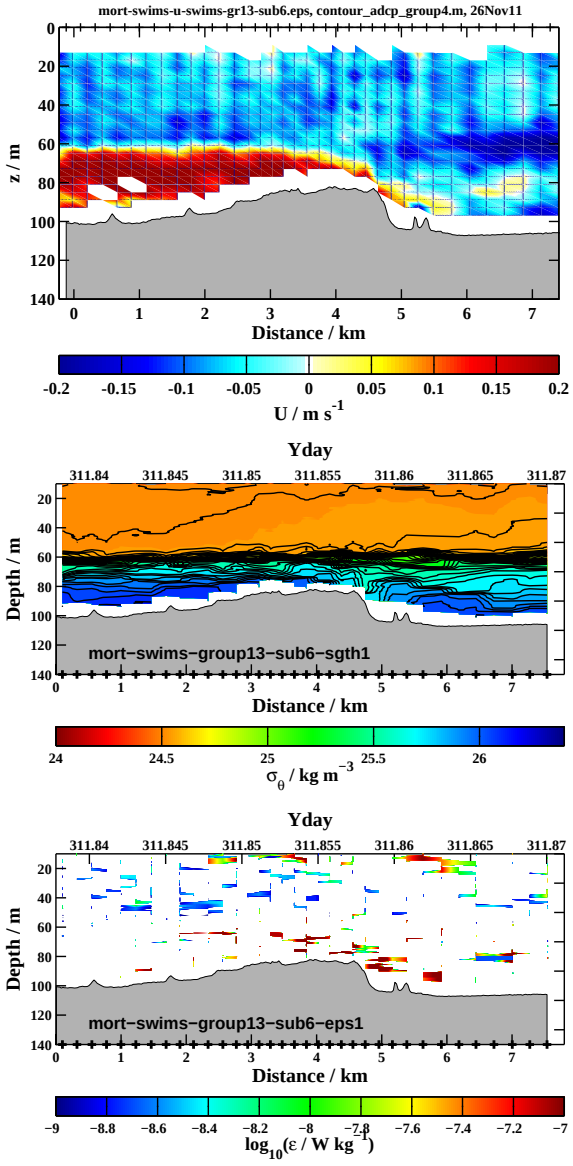

Figure 3: East/west velocity (top), potential density (middle), and turbulent dissipation rate, ε, (bottom) from leg 6 of the grid1 tow pattern. Dense water from the west pouring over the sill produced intense turbulence and homogenized water over the east side.

IMPACT/APPLICATIONS

Results from MORT are likely to improve representations of mixing over rough topography in coastal models used by the navy.

TRANSITIONS

It is too early to know how these results will be transitioned.

RELATED PROJECTS

The approach here is similar to that taken for ONR's AESOP program, my part of which focused on understanding and quantifying mixing over the continental shelf and upper slope in Monterey Bay.